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OBSERVATIONS ON THE ANATOMY OF FOLIAR NODES OF YOUNG *BRUGUIERA GYMNORRHIZA* (L.) LAM.

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Abstract

An anatomical investigation of young foliar nodes of *Bruguiera gymnorrhiza* (L.) Lam., has been made with particular reference to the vascular supply to the leaves and stipules. The nodal system is described and comment is made on the position of the system in hypotheses of nodal evolution in dicotyledons.

Introduction

The stem, root and leaf anatomy of *Bruguiera gymnorrhiza* (L.) Lam. has been reviewed by Metcalfe and Chalk (1950). Sinnott (1914) reports that in the Rhizophoraceae the node is trilacunar, i.e. that there are three stelar gaps associated with each leaf. Since the leaves are opposite, there would be a total of six gaps at each node. Unfortunately, he does not list the species investigated. In *B. gymnorrhiza*, there are eight gaps at each node. This system has, as far as the authors are aware, not been recorded in the Rhizophoraceae. The importance of the observation is twofold: it substantiates the view of Marsden and Bailey (1955) that the multilacunar nodal system arose by addition of lateral traces and it supports the contention of Sinnott (1914) that the Rhizophoraceae should, on the grounds of their nodal anatomy, be excluded from the Myrtiflorae.

The present work is the result of an investigation of the nodal region with particular reference to the origin of stipular and leaf vascular traces.

Materials and Methods

B. gymnorrhiza is indigenous to South Africa; the material used in this investigation was collected from the mangrove forests at Kosi Bay in northern Tongaland. Material was fixed in form-acetic alcohol, passed through a butyl alcohol series and imbedded in 50° paraffin wax. Sections were cut at 10μ on a Cambridge Rocker Microtome, stained with safranin and fast green and mounted in Canada balsam.

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OBSERVATIONS

The primary vascular tissue is differentiated as small colateral bundles which are very close together, giving the appearance of a continuous cylinder of vascular tissue (Plate 1).

The portions of the vascular tissue that form the leaf traces become distinct from the rest of the vascular tissue some distance below the node although they do not diverge until the node. In all, eight bundles become distinguishable, the two larger bundles being opposite and in the same vertical plane as the leaves they supply. They are, therefore, termed median traces. Three traces arise, equally spaced, on each side between these median traces and are collectively referred to as lateral traces (Plate 1).

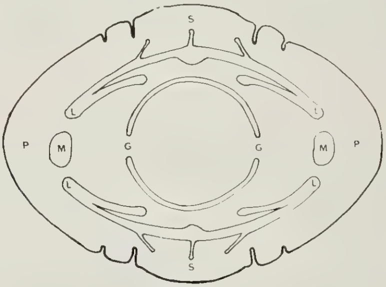

FIG. 1.
Diagrammatic representation of the vasculature of the foliar node. G, median leaf gap; L, lateral traces; M, median trace; P, base of petiole; S, base of stipule.

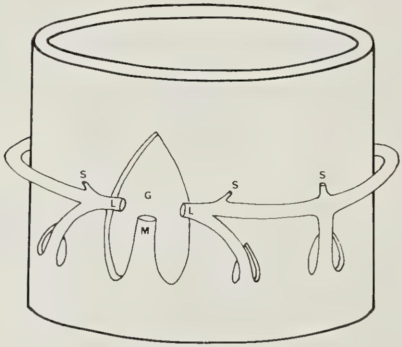

FIG. 2.
Diagrammatic representation of the vasculature of the foliar node. G, median leaf gap; L, lateral traces; M, median trace; S, stipular trace.

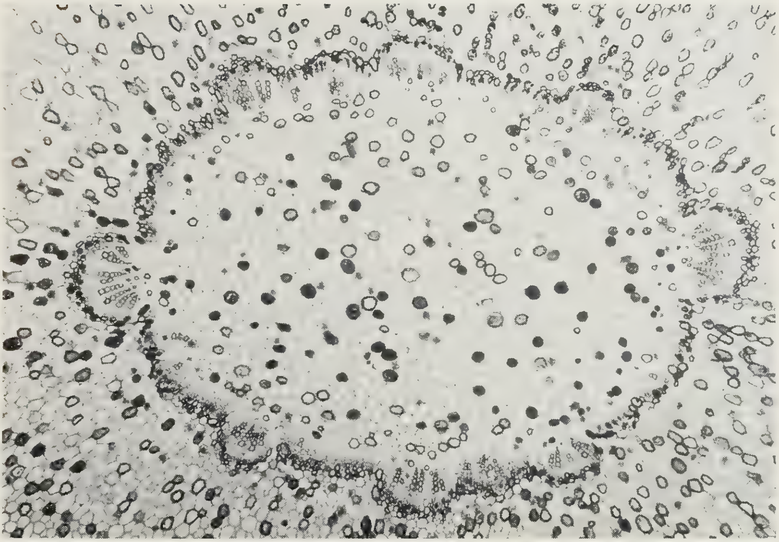

Plate 1.
Transection a short distance below the node. The eight traces forming the vasculature of the leaves and stipules are distinguishable. The larger two are median traces.

The traces all leave the cylinder together, the median traces forming a large leaf gap whilst the lateral traces leave small gaps which close soon after the traces leave the cylinder and before they enter the leaves and stipules (Plate 2). The gap formed by the departure of the median trace does not close until after the traces have entered the leaves and stipules (Plates 4 and 5).

The median traces move obliquely through the cortex to enter the base of the petiole. The six lateral traces diverge into the cortex whence they travel vertically for a short distance before they curve round to enter the base of the petiole (Plates 3 and 4, figures 1 and 2).

The central trace of each lateral group, after diverging from the vascular cylinder, splits into two major traces which curve in opposite directions and pass into the base of the petioles. These lateral divergences meet the traces arising from the lateral positions adjacent to the median trace. The two traces become closely associated and pass together into the base of the petiole (Plate 5, figures 1 and 2). Thus they enter as one vascular strand although they are derived independently. Although the petiole appears to receive three bundles in fact it is supplied by five traces: one from the cylinder directly in line with the base

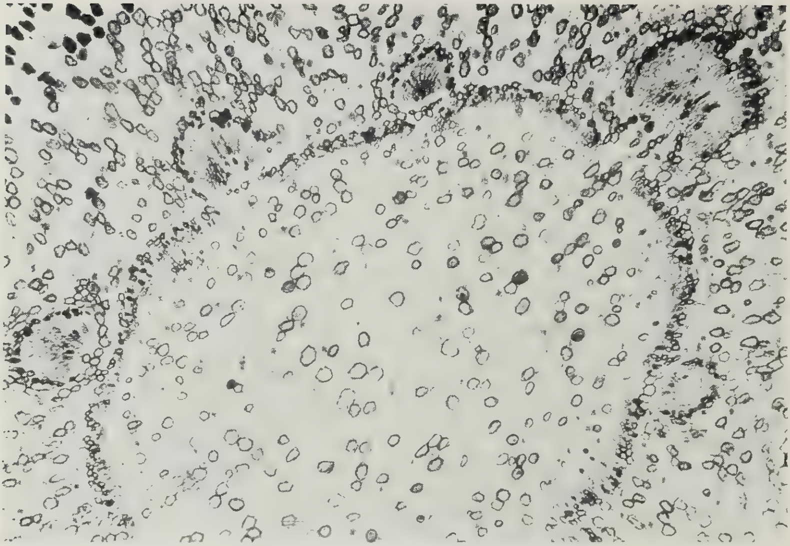

PLATE 2.
Transection of the lower part of the node. All traces leave the cylinder simultaneously. A large leaf-gap is formed where the median trace leaves the stele.

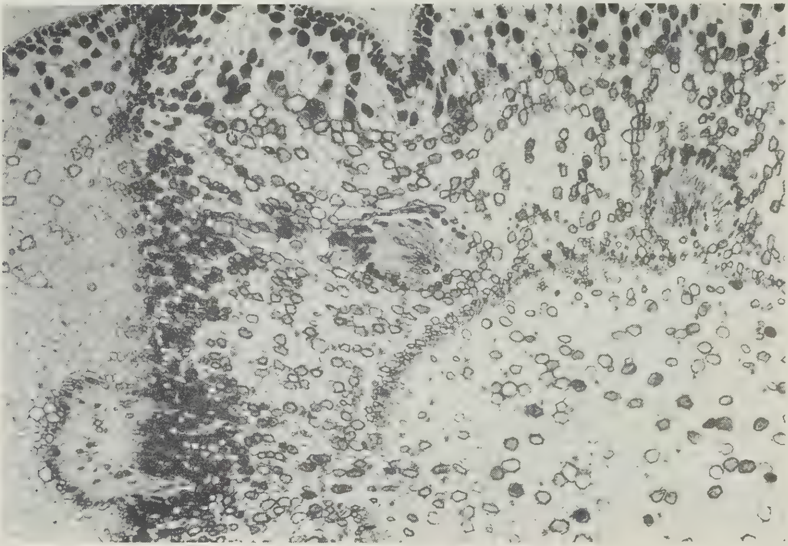

PLATE 3.
Transection through the node. The median trace enters the base of the petiole before the other traces.

of the petiole (median trace) and two on each side of this trace which are derived from the lateral traces.

The vascular supply to the interpetiolar stipules arises from the central of the three lateral traces on each side. The trace forming the mid-vein of each stipule arises at the point where the central lateral trace divides to form the traces to the leaves (Plate 6, figures 1 and 2). Each stipule has two other veins. These are positioned near the margin and they arise as small branches from the laterally diverging sections of the central lateral trace. They therefore arise in line with the margins of the stipule (Plate 7, figures 1 and 2). Each stipule receives three traces, all of which are derived from the central lateral trace.

In the nodal system, therefore, although each leaf receives five traces (making a total of ten traces), there are only eight gaps in the vascular cylinder. The system is termed multilacunar.

Discussion and Conclusions

In *B. gymnorrhiza*, the leaves are opposite and the stipules are inter-petiolar. Each leaf receives five traces although there are only eight gaps in the vascular

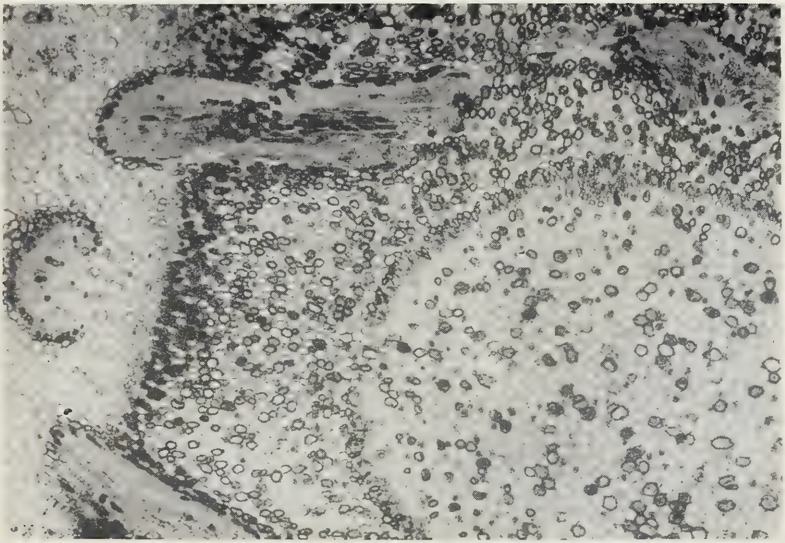

Plate 4.
Transection through the node. The lateral traces enter the base of the petiole together. Each petiole receives five traces.

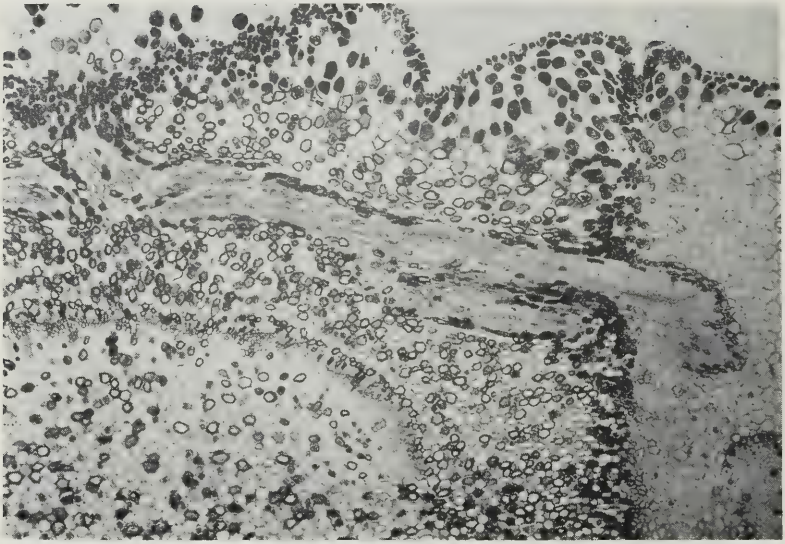

PLATE 5.
Transection through the node. Each central lateral trace diverges, the branches supplying different leaves.

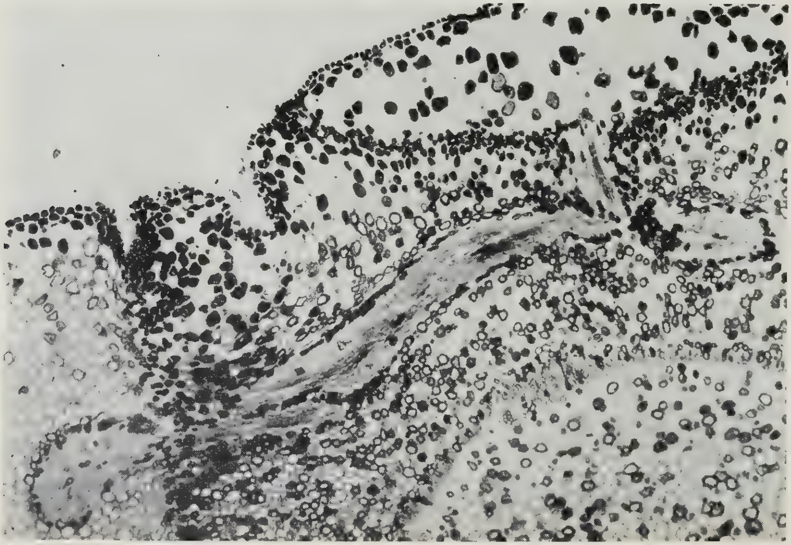

PLATE 6.
Transection through the node. Each stipule receives its marginal vascular supply from the branches of the central lateral trace.

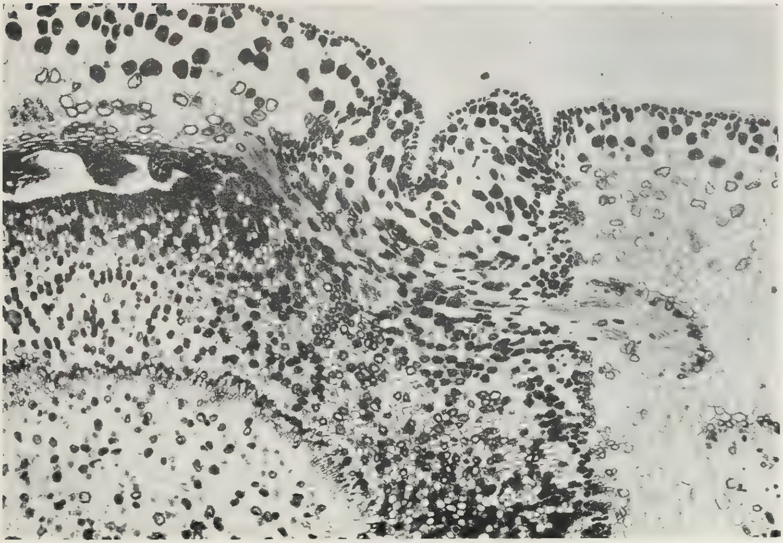

PLATE 7.
Transection through the node. The trace forming the mid-vein of the stipule arises where the central lateral trace divides.

system. The gaps are all one-trace lacunar. Each of the central lateral traces splits after departure from the cylinder and is, therefore, one-trace and not two-trace lacunar.

No reference to a nodal system of this type has been found in the literature available to the authors. Certainly, this system cannot be equated with that recorded by Sinnott (1914) as being trilacunar. However, the presence of a multilacunar system together with large stipules supports the contention of Sinnott and Bailey (1914) that, in the majority of plants with a trilacunar and presumably also a multilacunar system, stipules are present. These authors, however, state that a multilacunar condition is normally associated with plants having a sheathing base, a structure not present in *B. gymnorrhiza.* However, since the stipules are interpetiolar and inserted over a comparatively large area, the presence of a multilacunar condition is not surprising.

Sinnott (1914) reports that the Myrtiflorae are characterised by a unilacunar nodal system, and since the Rhizophoraceae were trilacunar, he contended that they should be excluded from the Myrtiflorae. This contention is supported by the present observation which demonstrates a system of nodal anatomy in the Rhizophoraceae even further removed from the unilacunar system.

Marsden and Bailey (1955) demonstrated that the unilacunar double-trace nodal arrangement was prevalent in the Pteropsida, exclusive of the Angiosperms. They suggested that this nodal condition may have been characteristic of ancestral angiosperms. Thus, the trilacunar and multilacunar arrangement would have arisen by addition of lateral traces in conjunction with the development of stipules and sheathing leaf bases. This is substantiated by the observations of Sinnott and Bailey (1914) who showed that most plants with trilacunar nodes have stipules and those with multilacunar nodes have sheathlike leaf bases.

Stipules are commonly accepted as being an integral part of the leaf because, even when they are separate appendages, they arise as outgrowths of the leaf primordia. Thus, interpetiolar stipules are considered to have arisen by fusion of adjacent stipules from opposite leaves. In *B. gymnorrhiza*, therefore, the median lateral traces can be considered as having arisen by fusion of two traces. The present system, where each leaf receives five traces although there are a total of only eight gaps, must have arisen from an arrangement where there were ten gaps at each node.

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REFERENCES

BAILEY, I. W. 1956. Nodal Anatomy in Retrospect. J. Arnold Arbor. **37**: 269-287.

MARSDEN, M. P. F. AND BAILEY, I. W. 1955. A Fourth type of Nodal Anatomy in Dicotyledons Illustrated by *Clerodendron trichotomum* Thunb. J. Arnold Arbor. **36**, 1-51.

SINNOTT, E. W. 1914. Investigations on the Phylogeny of the Angiosperms. I. The Anatomy of the Node as an aid in the Classification of Angiosperms. *Amer. J. Bot.* **I**, 303-322.

SINNOTT, E. W. AND BAILEY, I. W. 1914. Investigations on the Phylogeny of the Angiosperms. III. Nodal Anatomy and the Morphology of Stipules. *Amer. J. Bot.* **I**, 441-453.